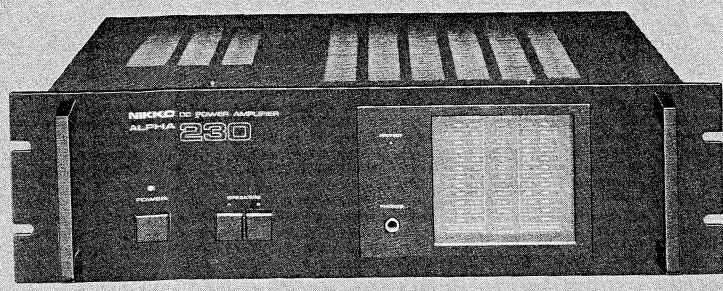
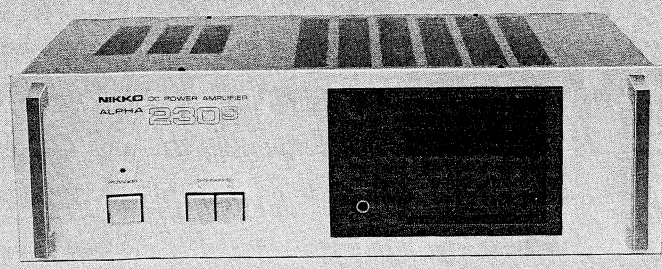
NIKKO POWER AMP

ALPHA 230
ALPHA 230s

STEREO POWER AMPLIFIER





TYPE AND VOLTAGE

W-TYPE:	UL and CSA type	120V AC
E -TYPE:	NK-STD type	220V AC
B -TYPE:	BS type	240V AC

SERVICE MANUAL

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SPECIFICATIONS

AMPLIFIER SECTION

Continuous Power Output per Channel:

- 20 ~ 20000 Hz (8 ohms) . . . . . more than 120 Watts
- 20 ~ 20000 Hz (4 ohms) . . . . . more than 130 Watts
- 1000 Hz (8 ohms) . . . . . more than 120 Watts
- 1000 Hz (4 ohms) . . . . . more than 130 Watts

T. H. Distortion, 8 ohms:

- at Continuous Power Output . . no more than 0.008%
- at 1 Watt Power Output . . . . . no more than 0.02%

T. H. Distortion, 4 ohms:

- at Continuous Power Output . . . no more than 0.02%

I. M. Distortion, 8 ohms:

- at Continuous Power Output . . . no more than 0.01%
- at 1 Watt Power Output . . . . . no more than 0.02%

IHF Power Bandwidth, 8 ohms: . . . . . 5 ~ 70000Hz

Damping Factor at 1000 Hz, 8 ohms: . . . . more than 60

Frequency Response, "NORMAL" input, 8 ohms:

- at 1 Watt power Output . . . 10 ~ 100000Hz +0, −1dB

Input Sensitivity for 120 Watts Power Output:

- MAIN IN . . . . . 1V ± 2dB

Signal to Noise Ratio, IHF "A" Network:

- MAIN (NORMAL, DIRECT) . . . . better than 105dB

Signal to Noise Ratio, DIN Filter:

- MAIN IN (NORMAL, DIRECT) . . better than 90dB

Channel Balance: . . . . . no more than 1dB

Residual Hum and Noise, 8 ohms: . . no more than 0.5mV

Idling Current: . . . . . 40 ~ 120mA

Midpoint Voltage: . . . . . 0 ± 20mV

Muting Delay Time: . . . . . 3 ~ 7 seconds

GENERAL

Power Requirement:

- W-TYPE . . . . . AC 120V, 60Hz
- E-TYPE . . . . . AC 220V, 50Hz
- B-TYPE . . . . . AC 240V, 50Hz

Power Consumption: . . . . . 480 W (620 VA)

Ambient Temperature during Operation: . . . −10 ~ 30°C

Dimensions:

- Width . . . . . 482 mm (19 inches)
- Height . . . . . 138 mm (5 1/3 inches)
- Depth . . . . . 344 mm (13 1/2 inches)

Weight, without package: . . . . . 13.5 kg (29.7 lbs)

*Specifications are subject to change without notice.

BLOCK DIAGRAM

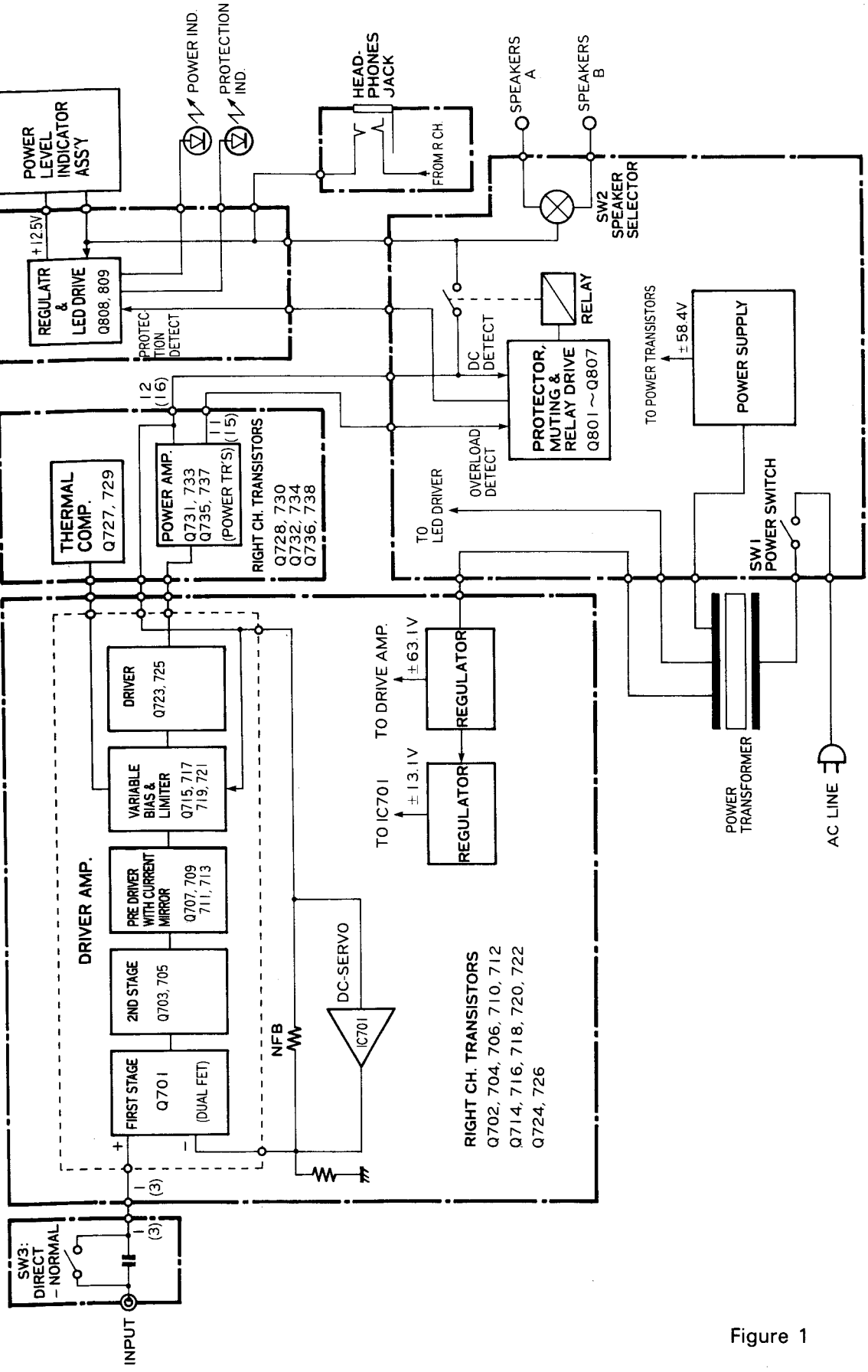


Figure 1

DISASSEMBLY

CABINET COVER REMOVAL

a. Remove four tapping screws from the top of the unit.

b. Remove four screws from both sides of the unit.

c. Lift the cabinet cover away from the unit.

BOTTOM PLATE REMOVAL

a. Remove nine tapping screws from the bottom of the unit as shown in Photo 1. (#1 – #9)

b. Lift the bottom plate away from the unit.

FRONT PANEL REMOVAL

a. Remove three tapping screws (#1 – #3) from the left side of the unit as shown in Photo 2.

b. Similarly remove three tapping screws from the right side of the unit.

c. Remove the front panel away from the unit by pulling it forward.

POWER TRANSFORMER REMOVAL

a. Remove the cabinet cover and the bottom plate.

b. Disconnect all the cables from the power transformer.

c. Remove four nuts (#1 – #4) from the chassis as shown in Photo 3.

d. Lift the power transformer away from the unit.

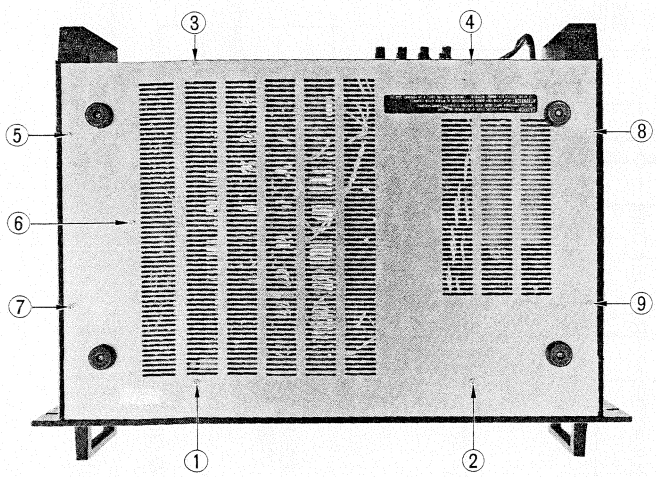


Photo 1

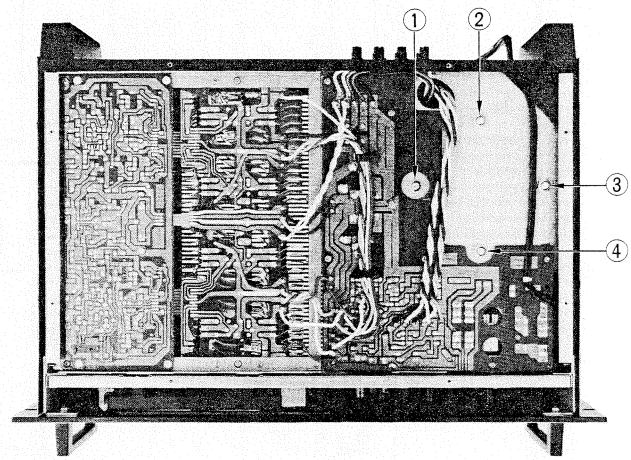


Photo 3

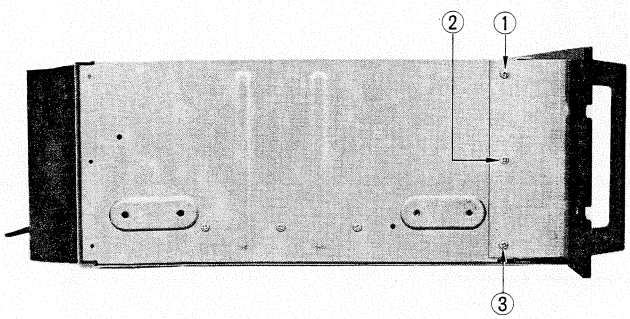


Photo 2

CIRCUIT DESCRIPTION

NIKKO's ALPHA 230, adopting latest devices such as Hi-fT power transistors, is of a design introducing a variable bias circuit (non-switching circuit), a DC servo circuit and other most advanced techniques.

For details, refer to page 2 "BLOCK DIAGRAM" and page 8 "SCHEMATIC DIAGRAM".

The following are explanations of the main circuits and devices.

1. VARIABLE BIAS CIRCUIT

Currently, in the output stage of power amplifiers are mostly used SEPP (Single Ended Push Pull) circuits. (Fig. 2).

It is generally known that the current (idle current) flowing through NPN and PNP transistors of this circuit can be classified into three large groups of operation form, class "A", class "AB" and class "B". (Fig. 3).

In class "A" operation, neither of collector currents, Q_1 and Q_2, becomes zero nor cut off. Even when the current flowing to the load R_L is zero, a certain current is flowing through Q_1 and Q_2, and so no crossover distortion exists theoretically.

To realize perfect class "A" operation, however, a current equal to or more than maximum output should continue to be let flow at the output stage as idle current, causing class "A" operation to prove to be a poor efficiency system.

In class "AB" or "B" operation, the Q_1 plays the role of amplification of the plus part of the signal and Q_2 that of the minus part, no matter whether idle current is large or small.

In other words, there definitely exists a period in which, when one transistor is on, the other transistor keeps cutting off, in these operations.

Switching distortion or crossover distortion is caused at the moment of this active status turning into cut-off status or the cut-off status into the active status. Nevertheless, as these operation forms have high efficiency with small idle current, it is much easier to use class "AB" or "B" operation for high power amplification rather than class "A".

A power amplifier enjoying the merit of each of these systems —— that is, practically no crossover or switching distortion being caused in class "A" operation and easier high power amplification being achieved by class "B" —— has been realized by adopting the variable bias circuit.

The idea of a variable bias circuit is that in no case the output stage is allowed to be cut-off by increasing and decreasing bias voltage in corresponding with the voltage of input signal.

Fig. 4 shows the variable vias circuit adopted in ALPHA 230.

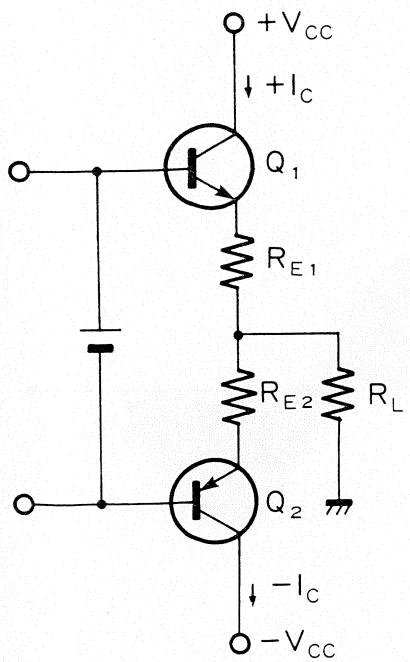


Figure 2 SEEP CIRCUIT

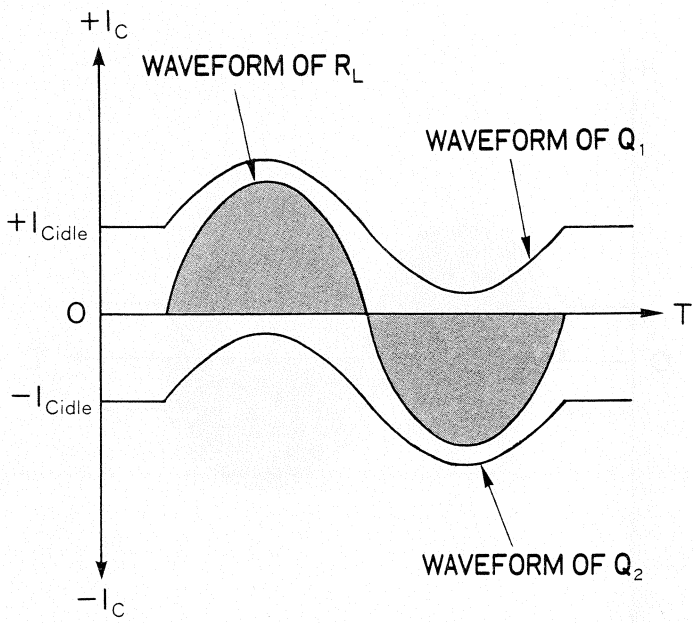


Figure 3-1 CLASS-A OPERATION

Now, suppose the plus wave (plus part) of signal has been inputted, the current of Qp_1 increases and the voltage at both ends of R_{E1} become high, resulting in the voltage between Ⓐ point and OUTPUT. At that time, the voltage at both ends of R_1 becomes high because current flows $R_1 \rightarrow D_1 \rightarrow Q_1$, causing the potential at Ⓒ point to lower and the voltage of Q_3 between collector and emitter to rise.
As a result, the voltage between Ⓐ and Ⓑ rises and Qp_2 is kept from being cut-off.
From another point of view, the voltage drops at the emitter resistor R_{E1} (these resistors are indispensable to protect transistors in stabilizing bias of the output stage or at the time of abnormal current flowing) is cancelled by the drop at R_1, thus protecting Qp_2 from becoming zero or anti-bias.

In the same manner, when the minus wave (minus part) of signal has been inputted, current flows $Q_2 \rightarrow D_2 \rightarrow R_2$, resulting in a rise of V_{CE} at Q_4 thus protecting Qp_1 from being cut-off.

2. DC SERVO CIRCUIT

DC amplification is the most advanced form adopted for audio amplifiers as there is no phase lag over all the range from DC to audio frequency.
However, in a perfect DC amplifier (which is an amplifier having no coupling capacitors in its input part and NFB loop), a DC drift is caused in case a direct current is inputted or when the DC balance between each element has been lost due to temperature rise inside the amplifier. The DC servo circuit is to suppress such a drift and realize a more stabilized amplifier.

The principle of a DC servo circuit is something like that of a comparator, in which changes in DC current between the output point and the ground is detected and drifts of the amplifier is controlled with their results used as the output of the servo circuit.

The basic elements are an integrating circuit composed of C_1 and R_1, an operational amplifier and a mirror integrator composed of C_2 and R_2. (Fig. 5).
Now, suppose a drift Δeo has been caused at the output of the power amplifier, a potential with the same phase Δef is outputted at the output of the operational amplifier.
On the other hand, the initial stage of the power amplifier is a differential amplifier. When Δef is inputted at its inverting input, the potential at the non-inverting input Δei changes in the opposite direction of Δef, resulting in a decrease of drift at the output of the power amplifier.
The DC servo circuit has a specific frequency characteristic. In the range of DC and ultra low frequency, gain of the power amplifier is kept at one over several tens of decibel, and in the audio frequency band, amplification at a certain gain can be made in the same manner as ordinary power amplifier.
The frequency on which the DC servo circuit starts to have effects is determined by the four elements, C_1, R_1, C_2 and R_2.

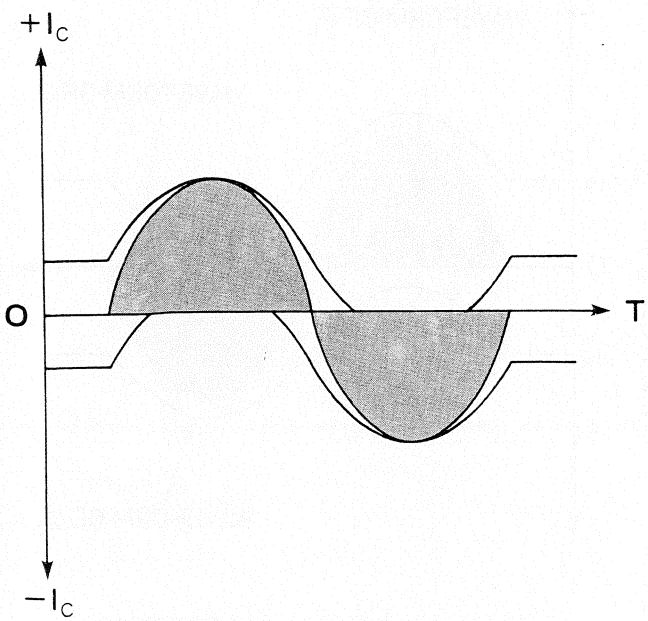


Figure 3-2 CLASS-AB OPERATION

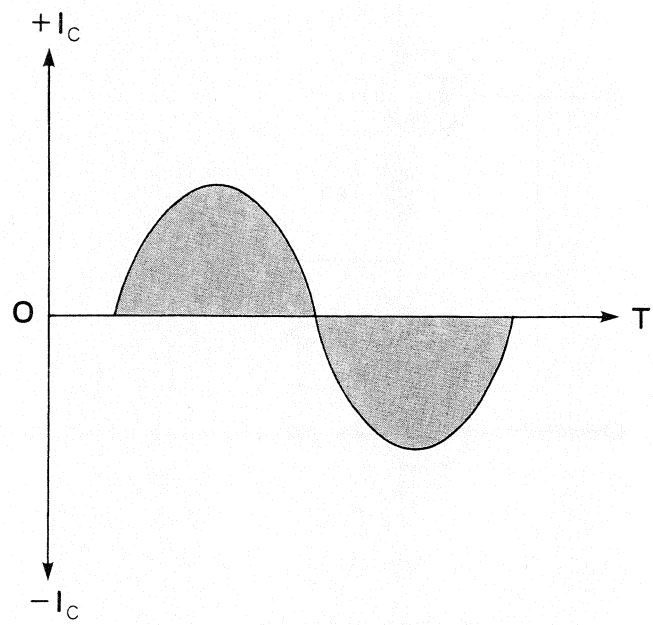


Figure 3-3 CLASS-B OPERATION

3. Hi-fT POWER TRANSISTORS

For detailes characteristics, refer to "SEMICONDUCTOR DATA" at the end of this manual.

The power transistors employed in ALPHA 230 realize an fT (Current Gain-bandwidth Product) of 80 MHz with NPN type and 60 MHz with PNP type (each being a typical value) in spite of its high Pc (Collector Power Dissipation) such as 150 W (The value when Tc = 25° C). Compared with conventional transistors with a Pc of 150 W where fT was around 10 MHz at maximum, the high speed attained by these Hi-fT power transistors is remarkable.

Such high fT has been realized specially by the inside construction of these transistors which is greatly different from that of conventional ones —— the multi-emitter construction.

In this construction, the emitter inside the transistor is divided into many units and emitter resistors with small resistance are inserted to each unit, resulting in a parallel connection.

This equivalently means that many small signal transistors with high fT and switching speed are parallelly connected, which has made it possible to realize such a high power characteristic while maintaining high switching speed.

Thanks to such construction as mentioned above, these power transistors are excellent in linearity of its *hfe*.

Furthermore, as dissipation is dispersed equally to each emitter due to the emitter-divided construction, they have another feature of being strong against breakdown as compared with conventional power transistors.

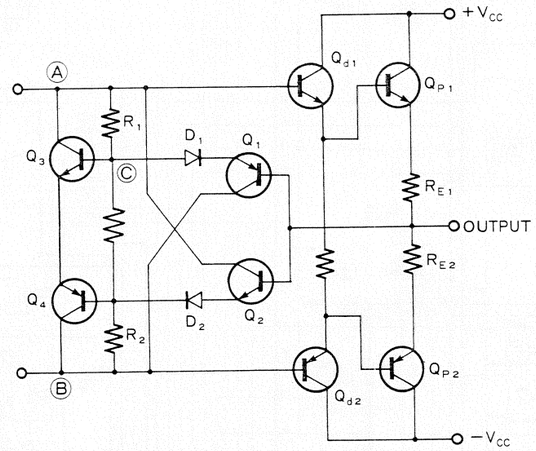


Figure 4 VARIABLE-BIAS CIRCUIT

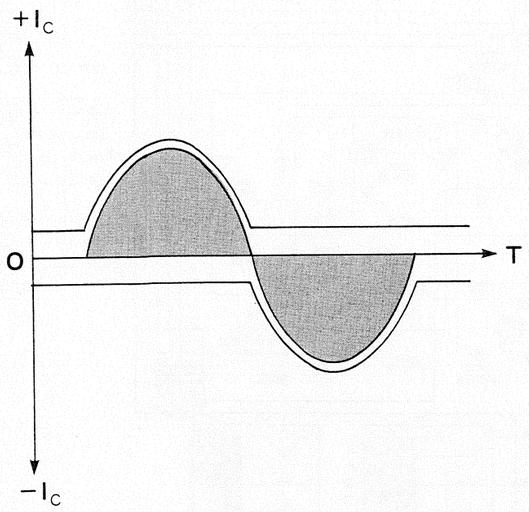


Figure 3-4 OPERATION OF BARIAVLE BIAS

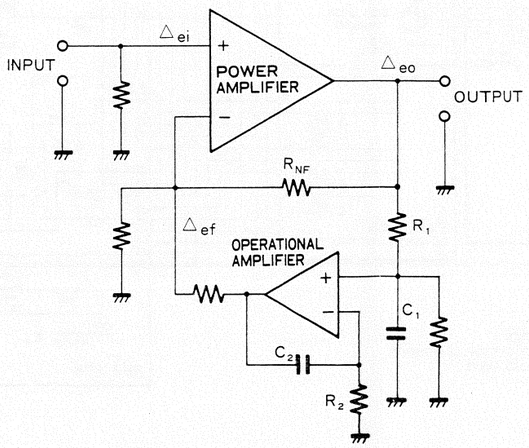


Figure 5 DC-SERVO CIRCUIT

PARTS LOCATION

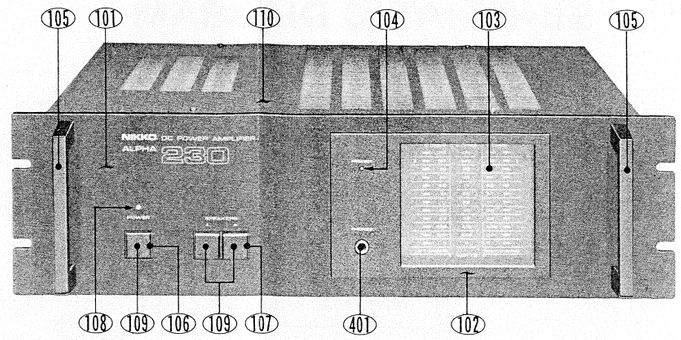


Photo 4

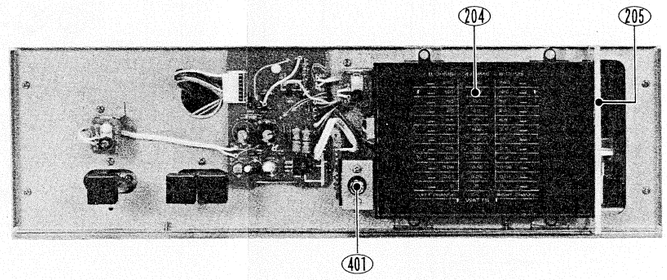


Photo 5

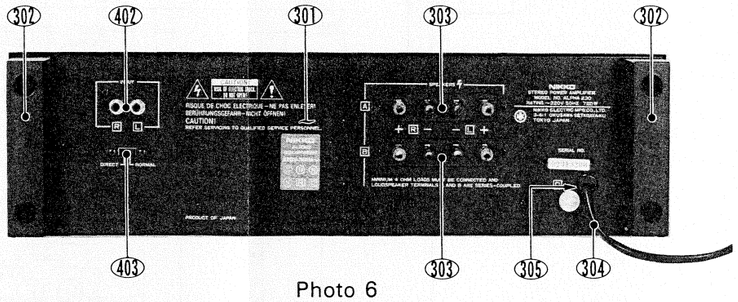


Photo 6

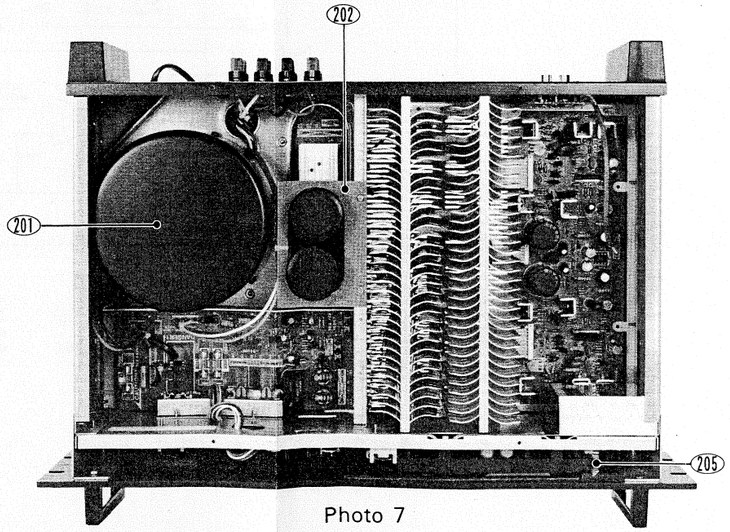
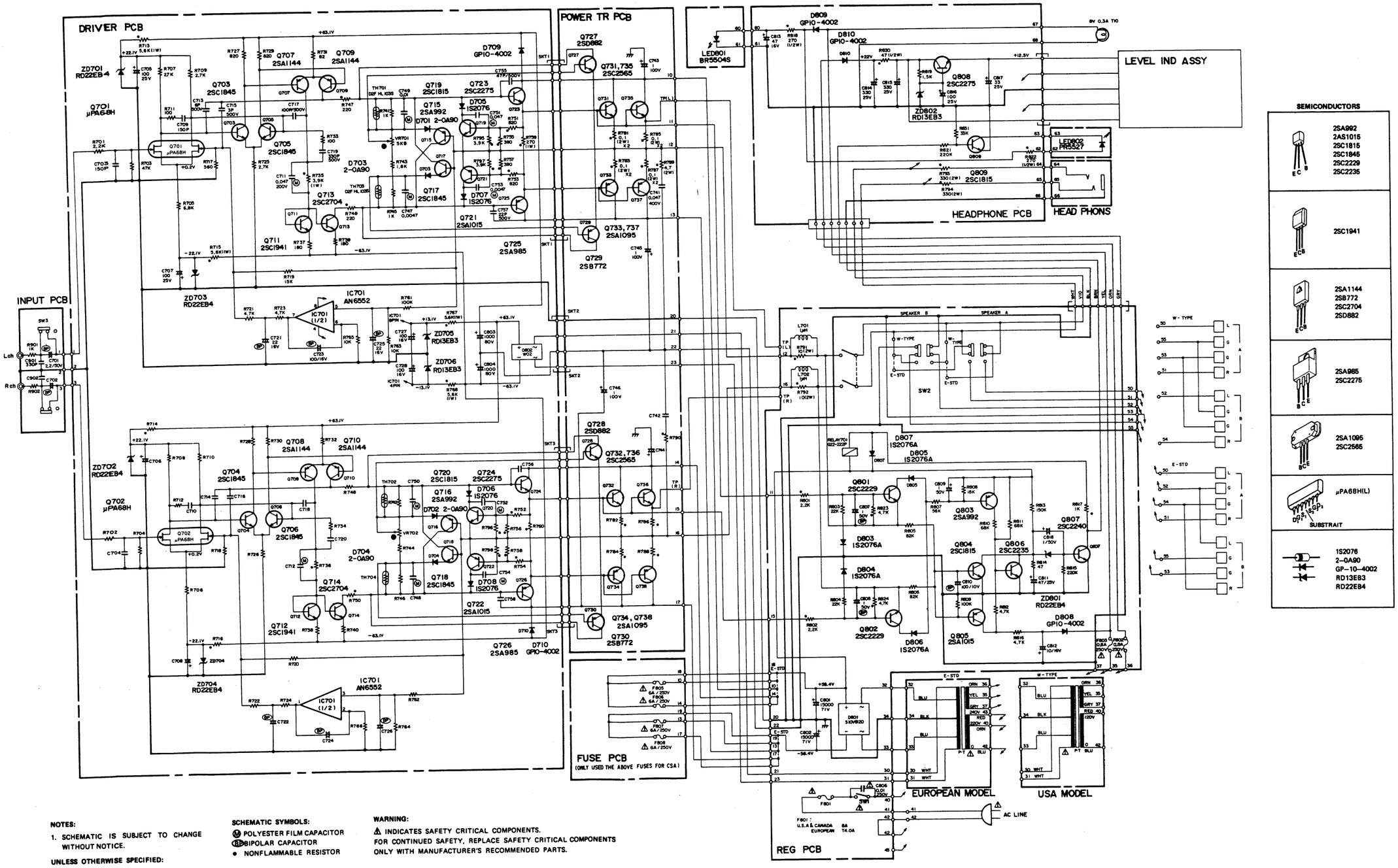


Photo 7

SCHEMATIC DIAGRAM



NOTES:

1. SCHEMATIC IS SUBJECT TO CHANGE WITHOUT NOTICE.

UNLESS OTHERWISE SPECIFIED:

2. RESISTANCE VARUES ARE IN OHMS. K = 1,000 ; M = 1,000,000
3. CAPACITANCE VALUES 1.0 AND ABOVE ARE IN pF OR μF (P = pF, M = μF), LESS THAN 1.0 ARE IN μF. (ELECTROLYTIC CAPACITANCE VALUES ARE IN μF/WV.)
4. VOLTAGES ARE MEASURED TO CHASSIS GROUND WITH A "DC VOLTMETER".

SCHEMATIC SYMBOLS:

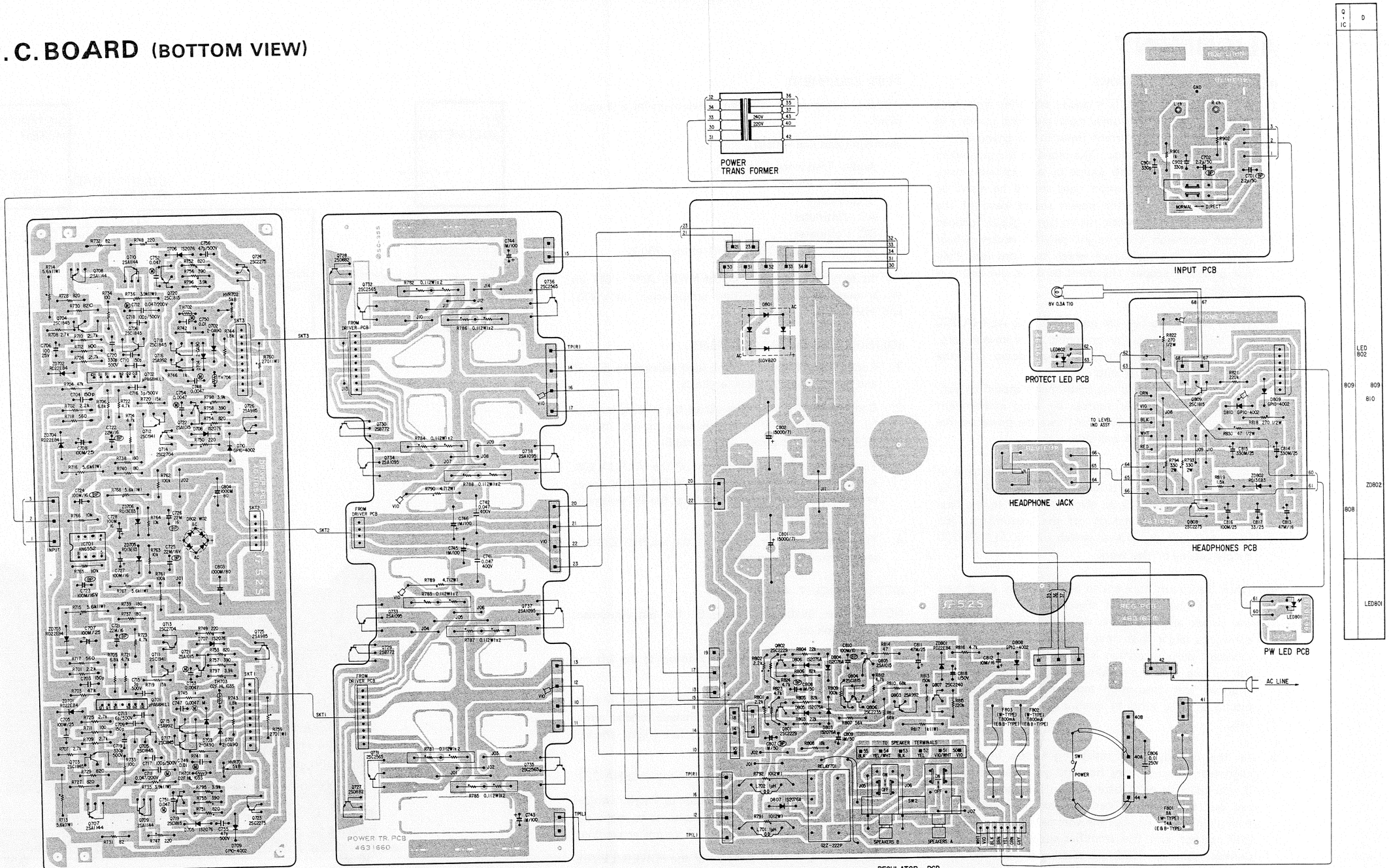
Ⓜ POLYESTER FILM CAPACITOR
Ⓑ BIPOLAR CAPACITOR
• NONFLAMMABLE RESISTOR

WARNING:

⚠ INDICATES SAFETY CRITICAL COMPONENTS.
FOR CONTINUED SAFETY, REPLACE SAFETY CRITICAL COMPONENTS ONLY WITH MANUFACTURER'S RECOMMENDED PARTS.

Figure 6

P.C.BOARD (BOTTOM VIEW)



Q · IC	708 704 710 706 702 720 718 716 712 714 713 722 711 721 701 715 705 717 703 719 707 724 726 725 723	728 730 732 734 733 729 731 727 736 738 737 735	805 802 801 804 806 803 807	
D	ZD702 ZD704 ZD706 ZD705 706 702 704 710 708 701 707 703 705 709 ZD703 ZD701		801 806 804 805 803 807 ZD801	808
ADJ	HVR702 HVR701			

Figure 7

ALIGNMENT

ALIGNMENT PRECAUTIONS

1. As the ALPHA 230 is a power amplifier with large output power, it consumes much electrical power and a great amount of current flows in the power source line of the primary side. Therefore, in the case when it is connected to the source by an extension cord, the size of the extension cord should be equal or larger than that of the power source cord of the ALPHA 230. Otherwise, the voltage might be reduced or the extension cord might generate excessive heat because of the resistance which the cord has, then not only can proper alignment be done, but also it is very dangerous.

2. If the power sources are supplied to the ALPHA 230 and the instruments by branching off from one cord, the voltage is sometimes dropped down and the stability of the instruments goes down.
   The ALPHA 230 and the instruments should be connected to the power sources by using independent cords. The ALPHA 230 must take the power source from AC outlet of the wall side.

3. As there are many parts which hold high voltages in the circuit and the parts inside of the ALPHA 230, be careful not to receive an electric shock. In the case of connecting and taking off the instruments, you must turn off the power switch of the ALPHA 230 before getting on the work.

4. When the circuit happens to be shorted by the drivers or test probes used for alignment through mistake, the circuit and the parts will be damaged. As the damage is larger than that of ordinary amplifiers and receivers, close attention is needed. It is advised that the turning driver, excluding the top part, should be wrapped with insulation tape or a driver made of plastic or some kind of insulating material should be used.

5. As the dummy load resistor generates heat while alignment, it gets very hot and you may be burnt if you touch it with bare hands. It is better if you can put the dummy load resistor in a place away from being touched, but the wire between the dummy load resistor and the amplifier should not be long. Contrive some method, like putting the dummy load resistor in a well ventilated box. Further, as more than 5 A current might flow in the wire connecting the dummy load resistor and the amplifier, at least larger than AWG #18 thick wire should be used.

6. All the adjustments in the following should be done after the slide switch on the rear panel is set in the "NORMAL" position.

TEST EQUIPMENT

Allow a minimum of 10 minutes warm-up for test equipment.

Maintain rated line voltage.

Audio Frequency Generator
Distortion Meter
Oscilloscope
AC Voltmeter
DC Voltmeter
2-Dummy Load Resistors, 8 ohms, 250 W

All the semi fixed resistors of the MAIN AMP PCB are set around the center position temporarily. (HVR701 and HVR702.)

IDLING CURRENT ADJUSTMENT

1. Connect the 8 ohms dummy load resistors to the left and right channel speaker terminals.
2. Connect the DC voltmeter across the wireing terminal No. 12 and "TP-L" (left channel) or No. 16 and "TP-R" (right channel). (see Photo 8)
3. Turning on the power switch of the ALPHA 230. Adjust the semi fixed resistor HVR701 (left channel) or HVR702 (right channel) so that the DC voltmeter indicates 18 mV ± 1 mV.
4. Turn off the power switch of the ALPHA 230 and remove the DC voltmeter.

METER CIRCUIT ADJUSTMENT

NOTE: See illustration, Figure 8, for test equipment hook-up.

1. Connect **8 ohms** dummy load resistors to the left and right channel speaker terminals.
2. Connect the AC voltmeter, distortion meter and the oscilloscope to the left (right) channel speaker terminals. Connect the generator to left (right) channel input terminal.
3. Turning on the power switch of the ALPHA 230.
4. Set the frequency of the generator to 1 KHz. Adjust the output level of the generator so as to make the output power 98 W. (28 V AC voltmeter reading.)
5. Adjust the semi-fixed resistors of the POWER LEVEL INDICATOR PCB, so that the LED of "120 W" dimly lights up.
6. Turning off the power switch of the ALPHA 230.
7. Remove all test equipment.

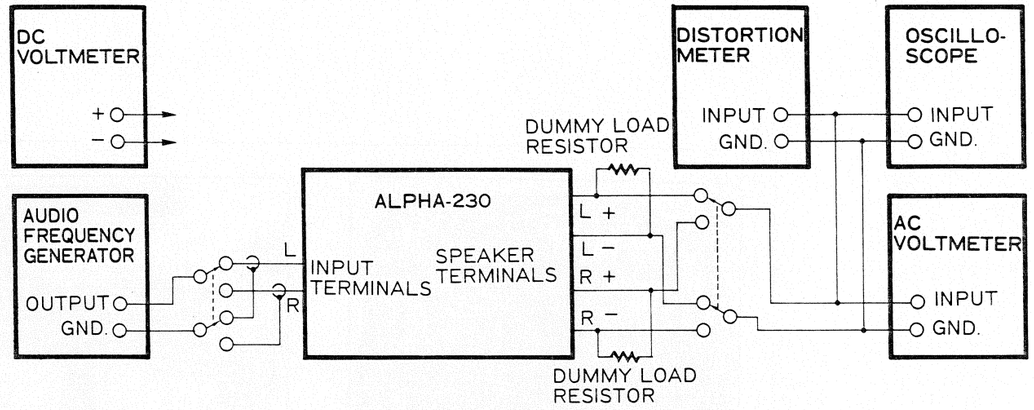


Figure 8 TEST EQUIPMENT HOOK-UP

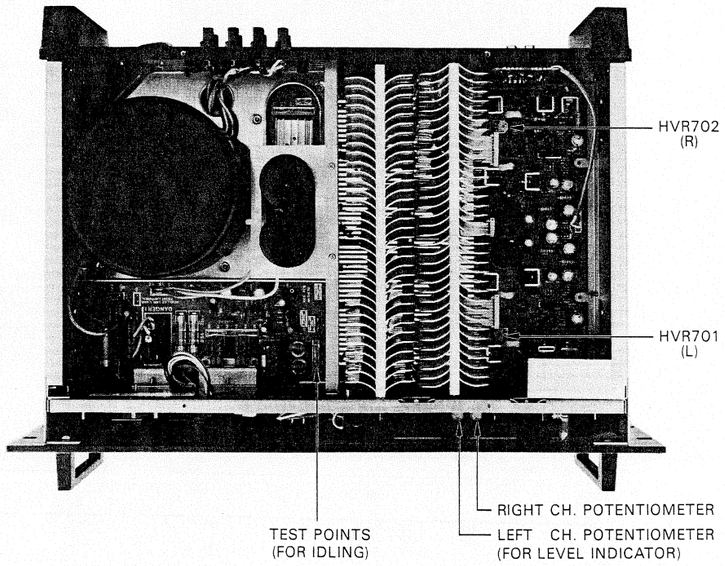


Photo 8 ADJUSTMENT POINTS

POWER TRANSISTORS MOUNTING ASSEMBLY

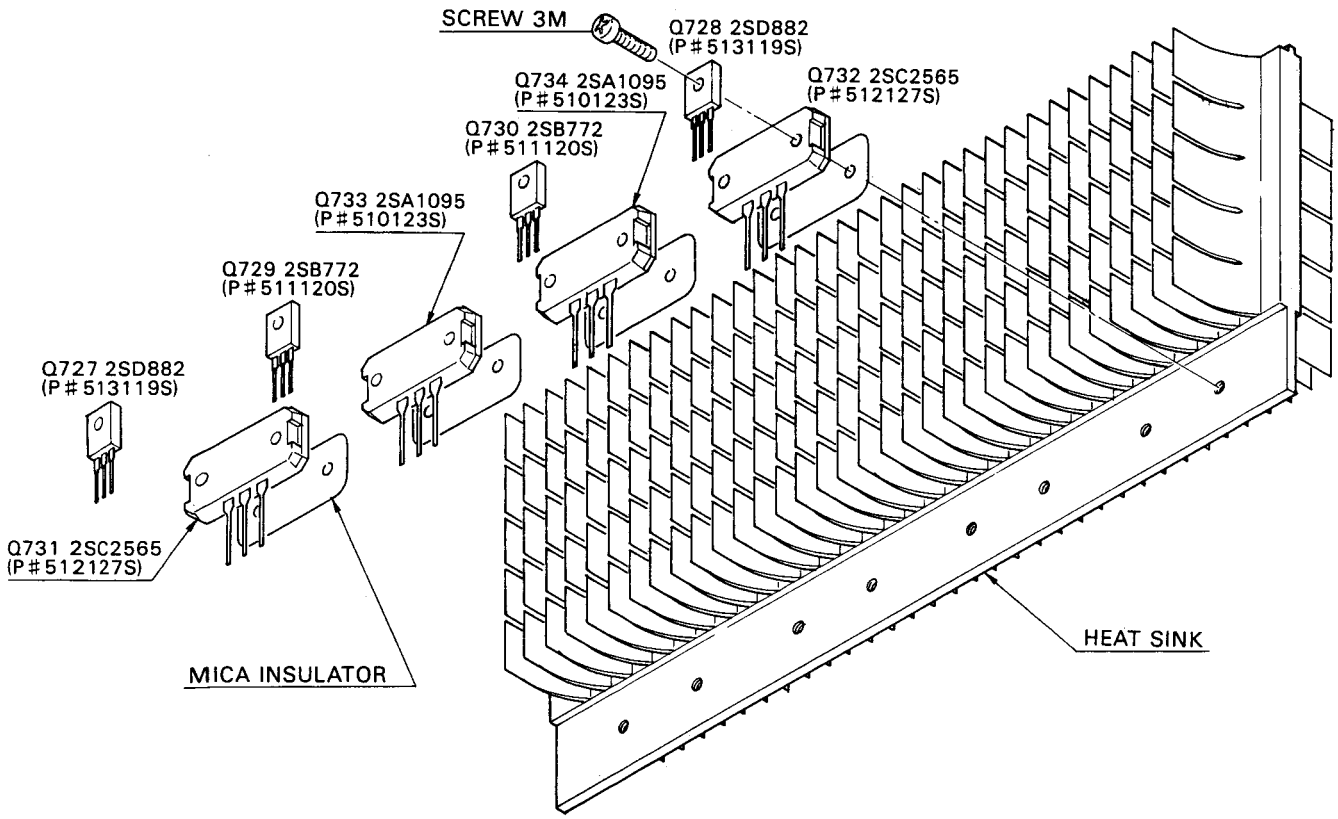


Figure 9

NOTE: For best heat conduction, use thermally conductive silicon grease between the power transistor and the mica insulator and between the insulator and the heat sink.

PRECAUTIONS FOR REPAIR SERVICE

Many of these items are included just as a reminder – they are normal procedures for experienced technicians. Short-cuts can be taken: but, often they cause additional damage to transistors, circuit components or the printed circuit board.

1. **Do not** bridge electrolytic capacitors with AC power. The resultant surges may damage solid state devices.
2. **Do not** bias the base of any transistor while voltage is being applied to its collector.
3. Replacements for output and driver transistors, if necessary, must be made from the same **hfe** group as the original type. Be sure to include this information when ordering replacement transistors.
4. If one output transistor burns out (open or shorts), always remove **all** output transistors in that channel and check the bias adjustment, the control and other parts in the network with an ohmmeter before inserting a new transistor. All output transistors in one channel will be destroyed if the base biasing circuit is open in the emitter end.

PARTS LIST

1. ★ The KEY NUMBER (#) marked with a (★) on parts list relate to number of three digits with a (◯). (Photo 4 ~ 7)
2. + Numberals in file indicate the quantity of parts used in one type.
3. ++ TR : Transistor
   FET : Field effect transistor
   VR : Volume control (Variable resistor)
   RES : Carbon film fixed resistor
   MO-RES : Metal oxide film fixed resistor
   CEM-RES : Cemented wirewound fixed resistor
   FP : Flame proof
   C-CAP : Ceramic capacitor
   E-CAP : Aluminum electrolytic capacitor
   M-CAP : Polyester film capacitor
   S-CAP : Polystyrene film capacitor
   T-CAP : Tantalum electrolytic capacitor
   BP-CAP : Bipolar electrolytic capacitor
   LC-CAP : Low current leakage electrolytic capacitor.
4. Assemblies and parts are subject to change without notice.
5. Parts ordering procedure:
   A. DO NOT USE THE "KEY" NUMBER AND "SYMBOL" NUMBER. (these are control # for the factory only)
   B. Include in any order
      a. Part number.
      b. Part description.
      c. Model number.

      (any of the above lacking from an order may delay shipment of that order.)

CAUTION:

The ⚠ mark, the KEY NO. and the SYMBOL NO. circled with rectangle in the schematic diagram and the shaded area in the parts list designate components which have special characteristics important for safety and should be replaced only with types identical to those in the original circuit or specified in the parts list.

KEY NO.	SYMBOL NO.	TYPE+ W E B	DESCRIPTION++	PART NO.
			PACKING MATERIALS & ACCESSORIES	
	001a	1 – 1	Carton box	9826730
	001b	– 1 –	Carton boxs	9826830
	002	2 2 2	Pad	9840970
	003	1 1 1	Sack, polyethylen cloth	9640740
	004	1 1 1	Sack, polyethylen cloth #13	9640320
	005a	1 – –	Manual, instructions – English and French	960431E
	005b	– 1 1	Manual, instructions – in five different languages	960431K
	006	1 – –	Manual, safety instructions	9670410
	007a	1 – –	Card, warranty 81-10	967046A
	007b	1 – –	Card, warranty – Canada	9670420
	008	1 – –	List, service stations	9690300
	009	1 1 1	Cord, RCA phono pin plug 2T-75	962026A
			CABINET ASSEMBLY	
	★101a	– 1 –	Panel, front – SILVER	7886440
	★101b	1 – 1	Panel, front – BLACK	7886430
	★102	1 1 1	Panel sash – 2 BK	7871240
	★103	1 1 1	Window, panel smoke	7803200
	★104	1 1 1	Globe, LED – protection indicator	7402540
	★105a	– 2 –	Handle – 100S – SILVER	7490350
	★105b	2 – 2	Handle – 100B – BLACK	7490190
	★106	1 1 1	Guide, button – 1P18 – power switch	7402550
	★107	1 1 1	Guide, button – 2P18 – sprks selector	7402560
	★108	1 1 1	Globe, LED – input power indicator	7402120
	★109a	3 – 3	Button, push M18BK – BLACK power/speakers	7852300
	★109b	– 3 –	Button, push M18GL – SILVER power/speakers	7853940
	★110	1 1 1	Cover, top	7821110
	111	1 1 1	Plate, bottom	7326430
	112	4 4 4	Foot, polyethylen – TG	7401350
			CHASSIS ASSEMBLY	
⚠	★201a	1 – –	Transformer, power T-1-412 AC120V	1104120
⚠	★201b	– 1 1	Transformer, power T-1-413 AC220V, 240V	1104130
	★202	1 1 1	Supporter, filter capacitors	7002510
	203	1 1 1	Level indicator assembly	4583170
	★204	1 1 1	Level indicator SCL	7803190
	★205	1 1 1	Meter reflex plate	7401580
	206	1 1 1	Lamp – 8V 0.3A	5808210
			BACK PLATE ASSEMBLY	
	★301a	1 – –	Plate, back – (W)	7328590
	★301b	– 1 1	Plate, back – (E)	7328600
	★302	2 2 2	Block, terminal guard	7401860
	★303	2 2 2	Terminal, speakers – screw type 4P	4450480
⚠	★304a	1 – –	Cord, AC line – SPT-2	606012A
⚠	★304b	– 1 1	Cord, AC line – CEE-2T	600508A
⚠	★305a	1 – –	Bush, power cord – SR-3P-4	7400620
⚠	★305b	– 1 1	Bush, power cord – SR-4N-4	7400690
			MAIN AMP PC BOARD ASSEMBLY	
			(POWER OUTPUT SECTION)	
	Q727,728	2 2 2	TR 2SD882	513119S
	Q729,730	2 2 2	TR 2SB772	511120S
	Q731,732, Q735,736 Q733,734	4 4 4	TR 2SC2565 (O or R)	512127S
	Q737,738	4 4 4	TR 2SA1095 (O or R)	510123S
	C741,742	2 2 2	M-CAP 0.047uf 10% 400V	273473K
	C743 ~ C746	4 4 4	E-CAP 1uf 100V	211810S
	R781 ~ R788	8 8 8	CEM-RES 0.1ohm 2Wx2	382109P
	R789,790	2 2 2	FP-MO-RES 4.7ohm 2W	362478L
			(DRIVER PCB SECTION)	
	IC701	1 1 1	IC AN6552	518096S
	Q701,702	2 2 2	FET μPA68H (L)	516050S
	Q703 ~ Q706, Q717,718 Q707	6 6 6	TR 2SC1845 (E or F)	512115S
	~ Q710	4 4 4	TR 2SA1144 (O or Y)	510120S
	Q711,712	2 2 2	TR 2SC1941 (L or K)	512112S
	Q713,714	2 2 2	TR 2SC2704 (O or Y)	512122S
	Q715,716	2 2 2	TR 2SA992 (E or F)	510110S
	Q719,720	2 2 2	TR 2SC1815 (Y or GR)	512107S
	Q721,722	2 2 2	TR 2SA1015 (Y or GR)	510102S
	Q723,724	2 2 2	TR 2SC2275 (P or O)	512120S
	Q725,726	2 2 2	TR 2SA985 (P or O)	510118S
	D701 ~ D704	4 4 4	Diode 2-0A90	500013G
	D705 ~ D708	4 4 4	Diode 1S2076	501019S
	D709,710	2 2 2	Diode GP10-4002	560066S
	D802	1 1 1	Diode W02	560061S

PART ORDERING PROCEDURE ----- DO NOT USE THE "KEY" NUMBER AND "SYMBOL" NUMBER. (these are control # for the factory only.) Include in any order: a. Part number, b. Part description, c. Model number. (any of the above lacking from an order may delay shipment of the order.)

KEY NO.	SYMBOL NO.	TYPE+ W E B	DESCRIPTION++	PART NO.
	ZD701			
	~ZD704	4 4 4	Zener diode RD22EB4	502059S
	ZD705,706	2 2 2	Zener diode RD13EB3	502063S
	TH701			
	~TH704	4 4 4	Thermistor D2FHL-103S	5400180
	C703,704,			
	C709,710	4 4 4	C-CAP 150pF 50V	232151K
	C705			
	~C708	4 4 4	E-CAP 100uf 25V	211330S
	C711,712	2 2 2	M-CAP 0.047uf 200V	272473K
	C713,714	2 2 2	C-CAP 6pF 500V	234609K
	C715,716	2 2 2	C-CAP 3pF 500V	234309K
	C717,718	2 2 2	C-CAP 100pF 500V	234101K
	C719,720	2 2 2	C-CAP 330pF 500V	234331K
	C721,722,			
	C725,726	4 4 4	BP-CAP 22uf 16V	215222N
	C723,724	2 2 2	BP-CAP 100uf 16V	215230N
	C727,728	2 2 2	E-CAP 100uf 16V	211230S
	C755,756	2 2 2	C-CAP 47pF	234470K
	C757,758	2 2 2	C-CAP 22pF	234220K
	C749,750	2 2 2	M-CAP 0.01uf 50V	222103J
	C747,748,			
	C753,754	4 4 4	M-CAP 0.0047uf	222472K
	C751,752	2 2 2	M-CAP 0.047uf 50V	222473K
	C803,804	2 2 2	E-CAP 1000uf 80V	2100130
	HVR701			
	~702	2 2 2	Potentiometer 5kohm	4301410
	R701,702	2 2 2	RES 2.2kohm 5% ¼W	328222J
	R703,704	2 2 2	RES 47kohm 5% ¼W	328473J
	R705,706	2 2 2	RES 6.8kohm 5% ¼W	328682J
	R725,726,			
	R707			
	~R710	6 6 6	RES 2.7kohm 5% ¼W	328272J
	R733,734,			
	R711,712	4 4 4	RES 100ohm 5% ¼W	328101J
	R767,768,			
	R713			
	~R716	6 6 6	FP-MO-RES 5.6kohm 5% 1W	361562L
	R717,718	2 2 2	RES 560ohm 5% ¼W	328561J
	R719,720	2 2 2	RES 15kohm 5% ¼W	328153J
	R721			
	~R724	4 4 4	4.7kohm 5% ¼W	328472J
	R727			
	~R730	4 4 4	RES 820ohm 5% ¼W	328821J
	R731,732	2 2 2	RES 82ohm 5% ¼W	328820J
	R735,736	2 2 2	FP-MO-RES 3.9kohm 5% 1W	361392L
	R737			
	~R740	4 4 4	RES 180ohm 5% ¼W	328181J
	R741,742,			
	R745,746	4 4 4	RES 1kohm 5% ¼W	328102J
	R743,744	2 2 2	RES 1.8kohm 5% ¼W	328182J
	R747			
	~R750	4 4 4	FP-RES 220ohm 5% ¼W	328221L
	R751			
	~R754	4 4 4	FP-RES 820ohm 5% ¼W	328821L
	R755			
	~R758	4 4 4	FP-RES 390ohm 5% ¼W	328391L
	R759,760	2 2 2	FP-MO-RES 270ohm 5% 1W	361271L
	R761,762	2 2 2	RES 100kohm 5% ¼W	328104J
	R763			
	~R766	4 4 4	RES 10kohm 5% ¼W	328103J
	R795			
	~R798	4 4 4	FP-RES 3.9kohm ¼W	328392L

REGULATOR PC BOARD ASSEMBLY

(REGULATOR SECTION)

KEY NO.	SYMBOL NO.	TYPE+ W E B	DESCRIPTION++	PART NO.
⚠	F801	1 – –	Fuse – 8A 250V MGC	4700760
⚠	F802,803	2 – –	Fuse – 0.8A 250V MGC	4700580
⚠	F801	– 1 1	Midget fuse – T4.0A 250V	4721020
⚠	F802,803	– 2 2	Midget fuse – T0.8A 250V	4720950
⚠	SW1	1 – –	Switch, push – SDZ-1PTV8 – power	4041830
⚠	SW1	– 1 1	Switch, push – ESB-90179S – power	4041600
	D801	1 1 1	Diode S10VB20	560058S
	C801,802	2 2 2	E-CAP 15000uf 71V	2100120
⚠	C806	1 – –	M-CAP 0.01uf 125V	284103M
⚠	C806	– 1 1	M-CAP 0.01uf 250V	283103M

(PROTECTOR SECTION)

KEY NO.	SYMBOL NO.	TYPE+ W E B	DESCRIPTION++	PART NO.
	SW2	1 1 1	Switch, twin push – SUF-24 – speakers	4041590
	RELAY1	1 1 1	Relay – G2Z-222P – DC24V	1700300
	Q801,802	2 2 2	TR 2SC2229 (Y)	512108S
	Q803	1 1 1	TR 2SA992 (Y or GR)	510110S
	Q804	1 1 1	TR 2SC1815 (Y or GR)	512107S
	Q805	1 1 1	TR 2SA1015 (Y or GR)	510102S
	Q806	1 1 1	TR 2SC2235	512109S
	Q807	1 1 1	TR 2SC2240 (GR, BL)	512102S
	D803			
	~D807	5 5 5	Diode 1S2076A	501020S
	D808	1 1 1	Diode GP10-4002	560066S
	ZD801	1 1 1	Zener diode RD22EB4	502059S
	L701,702	2 2 2	Coil, choke – 1uH	1210960
	C807,808	2 2 2	BP-CAP 1uf 50V	215510N
	C809,818	2 2 2	E-CAP 1uf 50V	211510S
	C810	1 1 1	BP-CAP 100uf 10V	215130N
	C811	1 1 1	E-CAP 47uf 25V	211325S
	C812	1 1 1	E-CAP 10uf 16V	211220S
	R791,792	2 2 2	FP-MO-RES 10ohm 5% 2W	362100L
	R801,802	2 2 2	RES 2.2kohm 5% ¼W	328222L
	R803,804	2 2 2	RES 22kohm 5% ¼W	328223J
	R805,806	2 2 2	RES 82kohm 5% ¼W	328823J
	R807	1 1 1	RES 56kohm 5% ¼W	328563J
	R808	1 1 1	RES 18kohm 5% ¼W	328183J
	R809	1 1 1	RES 100kohm 5% ¼W	328104J
	R810,811	2 2 2	RES 68kohm 5% ¼W	328683J
	R812,816	2 2 2	RES 4.7kohm 5% ¼W	328472J
	R813	1 1 1	RES 150kohm 5% ¼W	328154J
	R814	1 1 1	RES 47ohm 5% ¼W	328470J
	R815	1 1 1	RES 220kohm 5% ¼W	328224J
	R817	1 1 1	FP-MO-RES 1kohm 5% 1W	361102L
	R823,824	2 2 2	FP-RES 4.7kohm ¼W	328472L

(HEADPHONES PCB SECTION)

KEY NO.	SYMBOL NO.	TYPE+ W E B	DESCRIPTION++	PART NO.
★401		1 1 1	Jack, headphones	4550260
	Q808	1 1 1	TR 2SC2275 (P or Q)	512120S
	Q809	1 1 1	TR 2SC1815 (Y or GR)	512107S
	D809,810	2 2 2	Diode GP10-4002	560066S
	ZD802	1 1 1	Zener diode RD13EB3	502063S
	C813	1 1 1	E-CAP 47uf 16V	211225S
	C814,815	2 2 2	E-CAP 330uf 25V	211333S
	C816	1 1 1	E-CAP 100uf 25V	211330S
	C817	1 1 1	E-CAP 33uf 25V	211323S
	R793,794	2 2 2	FP-MO-RES 330ohm 5% 2W	362331L

PART ORDERING PROCEDURE ----- DO NOT USE THE "KEY" NUMBER AND "SYMBOL" NUMBER. (these are control # for the factory only.) Include in any order: a. Part number, b. Part description, c. Model number. (any of the above lacking from an order may delay shipment of the order.)

KEY NO.	SYMBOL NO.	TYPE+ W E B	DESCRIPTION++			PART NO.
	R818,822	2 2 2	FP-RES 270ohm	5%	½W	329271L
	R819	1 1 1	RES 1.5kohm	5%	¼W	328152J
	R821	1 1 1	RES 220kohm	5%	¼W	328224J
	R830	1 1 1	FP-RES 470ohm		½W	329470L
	R831	1 1 1	RES 33kohm		4W	328333J
			(INPUT PCB SECTION)			
*402		1 1 1	Terminal, RCA phono pin jack – 2P			4442070
*403	SW3	1 1 1	Switch, slide – SSB-022 – normal-direct selector			4020710
	C701,702	2 2 2	BP-CAP 2.2uf 50V			215512N
	C901,902	2 2 2	C-CAP 330pF 50V			232331K

KEY NO.	SYMBOL NO.	TYPE+ W E B	DESCRIPTION++			PART NO.
	R901,902	2 2 2	RES 1kohm	5%	¼W	328102J
			(POWER INDICATOR SECTION)			
	LED801	1 1 1	LED BR5504S			5060300
		1 1 1	Spacer, LED			7903140
			(PROTECTION INDICATOR SECTION)			
	LED802	1 1 1	LED PR5527S			5060270
		1 1 1	Spacer, LED			7903110

SEMICONDUCTOR DATA

TRANSISTORS

† NOTES Ge: Germanium Si: Sillicon

A: Alloy B: Base D: Diffused Dd: Double-diffused Df: Drift-field E: Epitaxial G: Grown J: Junction M: Mesa P: Planer Pc: Point-contact Td: Triple-diffused

DEVICE TYPE	APPLICATIONS	STRUCTURE†	MAXIMUM RATINGS Absolute-Maximum Values: (T_A = 25°C unless otherwise specified)					ELECTRICAL CHARACTERISTICS Typical Values: (T_A = 25°C unless otherwise specified)														MANUFACTURER
			Collector-to-Base Voltage V_{CBO} (V)	Emitter-to-Base Voltage V_{EBO} (V)	Collector Current I_C (mA)	Collector Dissipation P_C (mW)	Junction Temperature T_J (°C)	Collector Cutoff Current I_{CBO} (uA)	V_{CB} (V)	Static Forward-Current Transfer Ratio h_{FE}	V_{CE} (V)	I_C (mA)	Collector-Emitter Saturation Voltage $V_{CE(sat)}$ (V)	I_C (mA)	I_B (mA)	Gain-Bandwidth Product f_T f_{ob}* (MHz)	V_{CE} V_{CB}* (V)	I_E I_C* (mA)	Output Capacitance Cob (pF)	Others	
2SA985 (P, Q)	AF, Power amp.	PNP Si-E	−120	−5	−1.5A	25W (Tc=25°C)	150	−1 max.	−120	100 ~ 320	−5	−300	−2 max.	−1A	−100	180	−5	−200*	29	Complementary to 2SC2275	NEC
2SA992 (E, F)	AF, Low noise	PNP Si-E	−120	−5	−50	500	125	−0.05 max.	−120	300 ~ 800	−6	−0.1	−0.3 max.	−10	−1	100	−6	1	3 max.	Complementary to 2SC1845	NEC
2SA1015 (Y, GR)	AF, General	PNP Si-E	−50	−5	−150	400	125	−0.1 max.	−50	120 ~ 400	−6	−2	−0.3 max.	−100	−10	80 min.	−10	−1*	7 max.	Complementary to 2SC1815	TOSHIBA
2SA1095 (O, R)	AF, Power amp.	PNP Si-E	−160	−5	−15A	150W (Tc=25°C)	150	−50 max.	−160	55 ~ 160	−5	−1A	−2 max.	−5A	−500	60	−10	−1A*	350	Complementary to 2SC2565	TOSHIBA
2SA1144 (O, Y)	AF, Driver	PNP Si-E	−150	−5	−50	10W (Tc=25°C)	150	−0.1 max.	−150	80 ~ 240	−5	−10	1 max.	−10	−1	120	−5	−10*	2.5	Complementary to 2SC2704	TOSHIBA
2SB772 (P, Q)	AF, Power amp.	PNP Si-E	−40	−5	−3A	1W	150	−1 max.	−30	100 ~ 320	−2	−20	−0.5 max.	−2A	−200	80	−5	100	55	Complementary to 2SD882	NEC
2SC1815 (Y, GR)	AF, General	NPN Si-E	60	5	150	400	125	0.1 max.	60	120 ~ 400	6	2	0.25 max.	100	10	80 min.	10	1*	3 max.	Complementary to 2SA1015	TOSHIBA
2SC1845 (E, F)	AF, Low noise	NPN Si-E	120	5	50	500	125	0.05 max.	120	300 ~ 800	6	0.1	0.3 max.	10	1	110	6	−1	2.5 max.	Complementary to 2SA992	NEC
2SC1941 (L, K)	AF, Driver	NPN Si-E	160	5	50	800	150	0.1 max.	160	135 ~ 400	10	1	0.6 max.	20	2	120	10	−10	3 max.		NEC
2SC2229 (O, Y)	AF, Driver	NPN Si-Td	200	5	50	800	150	0.1 max.	200	70 ~ 240	5	10	0.5 max.	10	1	120	30	10*	5 max.		TOSHIBA
2SC2235 (O, Y)	AF, Driver	NPN Si-E	120	5	800	900	150	1 max.	120	80 ~ 240	5	100	1 max.	500	50	120	5	100*	30 max.		TOSHIBA
2SC2240 (GR, BL)	AF, Low Noise	NPN Si-E	120	5	100	300	125	0.1 max.	120	200 ~ 700	6	2	0.3 max.	10	1	100	6	1*	3		TOSHIBA
2SC2275 (P, Q)	AF, Power amp.	NPN Si-E	120	5	1.5A	25W (Tc=25°C)	150	1 max.	120	100 ~ 320	5	300	2 max.	1A	100	200	5	200*	19	Complementary to 2SA985	NEC
2SC2565 (O, R)	AF, Power amp.	NPN Si-E	160	5	15A	150W (Tc=25°C)	150	50 max.	160	55 ~ 160	5	1A	2 max.	5A	500	80	10	1A*	200	Complementary to 2SA1095	TOSHIBA
2SC2704 (O, Y)	AF, Driver	NPN Si-E	150	5	50	10W (Tc=25°C)	150	0.1 max.	150	80 ~ 240	5	10	1 max.	10	1	200	5	10*	1.8	Complementary to 2SA1144	TOSHIBA
2SD882 (P, Q)	AF, Power amp.	NPN Si-E	40	5	3A	1W	150	1 max.	30	100 ~ 320	2	20	0.5 max.	2A	200	90	5	−100	45	Complementary to 2SB772	NEC

FIELD EFFECT TRANSISTOR

DEVICE TYPE	APPLICATIONS	STRUCTURE†	MAXIMUM RATINGS Absolute-Maximum Values: (T_A = 25°C unless otherwise specified)						ELECTRICAL CHARACTERISTICS Typical Values: (T_A = 25°C unless otherwise specified)																MANUFACTURER
			Gate-to-Drain Voltage V_{GDO} (V)	Gate-to-Source Voltage V_{GSO} (V)	Gate Current I_G (mA)	Drain Current I_D (mA)	Total Dissipation P_D (mW)	Channel Temperature T_{ch} (°C)	Gate Leak Current Test Conditions	I_{GSS} (nA)	Gate to Drain Breakdown Voltage Test Conditions	$V_{(BR)GDO}$ (V)	Drain Current Test Conditions	I_{DSS} (mA)	Gate to Source Cutoff Voltage Test Conditions	$V_{GS(off)}$ (V)	Forward Transfer Admittance Test Conditions	$\|Y_{fs}\|$ (mS)	Feed Back Capacitance Test Conditions	C_{rss} (pF)	Power Gain (Common Source) Test Conditions	G_{PS} (dB)	Noise Figure Test Conditions	NF (dB)	
μPA68H (L)	AF, Low noise Differential amp.	Si N-channel junction (Dual)	−50	−50	10		200/unit	125	V_{GS}=−30V V_{DS}=0	−1 max.			V_{DS}=10V V_{GS}=0	2.6 ~ 6.5			V_{DS}=10V V_{GS}=0 f=1 kHz I_{DSS}=3mA	12	V_{DG}=10V I_D=0 f=1 MHz	3			V_{DS}=10V R_g=1 kΩ I_D=1 mA f=1 kHz	2 max.	TOSHIBA

DIODES, LED'S

DEVICE TYPE	APPLICATIONS	STRUCTURE†	MAXIMUM RATINGS Absolute - Maximum Values: (T_A = 25°C unless otherwise specified)									ELECTRICAL CHARACTERISTICS Typical Values: (T_A = 25°C unless otherwise specified)							MANU-FACTURER
			Reverse Surge Voltage	Peak Reverse Voltage	Reverse Voltage	Peak Forward Voltage	Peak Forward Current	Average Rectified Current	Forward Surge Current	Junction Temperature	Total Power Dissipation	Forward Current		Forward Voltage		Reverse Current		Others	
			V_{Rsurge} (V)	V_{RM} (V)	V_R (V)	V_{FM} (V)	I_{FM} (mA)	I_O (mA)	$I_{F\ surge}$ (A)	T_J (°C)	P_D (mW)	I_{Fmin} (mA)	Test Condition V_F (V)	V_{Fmax} (V)	Test Condition I_F (mA)	I_{Rmax} (uA)	Test Condition V_R (V)		
2-0A90	Detector	Ge-Pc			15		150		0.4	75		4	1						MATSUSHITA
1S2076	Medium speed Switching	Si-EP		35	30		450	150	1	175	250			0.8	10	1	30		HITACHI
1S2076A	Medium speed Switching	Si-EP		70	60		450	150	1	175	250			0.8	10	1	30		HITACHI
GP10 -4002	Rectifier	Si-DJ		100	70			1A	30	175				1.1	1A	5			GENERAL INSTRUMENT
W02	Rectifier	Si-DJ (Bridge)			200	200		1.5A	50	125				1.0	1A	10		R_{th} = 50°C/W	GENERAL INSTRUMENT
S10VB20	Rectifier	Si-DJ (Bridge)		200				10A	200	150				1.05		10			SHINDENGEN
BR5504S	Lamp (red)	GaAlAs			4		300	I_F = 50		85	100			2.0	20	100	4	I_V = 80 mcd (I_F = 20 mA)	STANLEY
PR5527S	Lamp (red)	GaP			4		100	I_F = 30		85	75			2.0	10	100	4	I_V = 1.2 mcd (I_F = 10 mA)	STANLEY

ZENER DIODES

DEVICE TYPE	APPLICATIONS	STRUCTURE†	MAXIMUM RATINGS Absolute - Maximum Values: (T_A = 25°C unless otherwise specified)			ELECTRICAL CHARACTERISTICS Typical Values: (T_A = 25°C unless otherwise specified)												Others	MANU-FACTURER
			Total Power Dissipation	Zener Current	Junction Temperature	Zener Voltage V_Z			Test Conditions	Differential Resistance r_Z		Test Conditions	Temperature Coefficient γ_Z		Test Conditions	Reverse Current			
			P_D (mW)	I_Z (A)	T_J (°C)	MIN (V)	TYP (V)	MAX (V)	I_Z (mA)	TYP (Ω)	MAX (Ω)	I_Z (mA)	TYP (%/°C)	MAX (%/°C)	I_Z (mA)	MAX (μA)	Test Conditions V_R (V)		
RD13EB3	Regulator	Si-J	400		175	12.99		13.66	10		25	10				2	10		NEC
RD22EB4	Regulator	Si-J	400		175	21.52		22.63	5		60	5				2	17		NEC

INTEGRATED CIRCUITS AN6552

- **Manufacturer:** MATSUSHITA
- **Applications:** Dual Operational Amplifier

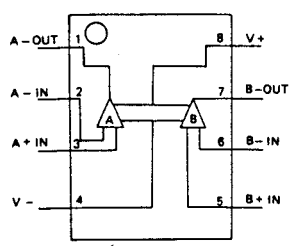
ABSOLUTE MAXIMUM RATINGS

Supply Voltage	±18 V	Input Voltage	±15 V
Internal Power Dissipation	500 mW	Storage Temperature Range	−40°C to +125°C
Differential Input Voltage	±30 V	Operating Temperature Range	−20°C to +75°C

ELECTRICAL CHARACTERISTICS (V_{CC} = ±15V, T_A = +25°C unless otherwise noted.)

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Input Offset Voltage	$R_S \leqslant 10\ k\Omega$		0.5	6.0	mV
Input Offset Current			5	200	nA
Input Bias Current				500	nA
Large-Signal Voltage Gain	$R_L \geqslant 2\ k\Omega$ V_{out} = ±10V	86	100		dB
Output Voltage Swing	$R_L \geqslant 2\ k\Omega$	±10	±13		V
Common Mode Rejection Ratio	$R_S \leqslant 10\ k\Omega$	70	90		dB
Supply Voltage Rejection Ratio	$R_S \leqslant 10\ k\Omega$		30	150	μV/V
Slew Rate	$R_L \geqslant 2\ k\Omega$		1		V/μS

TERMINAL GUIDE (TOP VIEW)



SCHEMATIC DIAGRAM (1/2 CIRCUIT)